THE FORMATION OF SEDIMENTARY STRATA ON CONTINENTAL MARGINS

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LONG-TERM GOALS

The ultimate goal of this research is to understand the mechanisms by which continental-margin sediment is deposited, modified and preserved, so strata recorded over various time scales (events to millennia) can be interpreted better.

SCIENTIFIC OBJECTIVES

The field work is undertaken on the Eel margin within the larger context of the STRATAFORM program, and has objectives that complement those of other groups. In particular, this project is designed to document shelf event beds (i.e., flood, storm) immediately after they form, to observe their subsequent modification and preservation, and to interpret geologic history from old beds buried at various depths within the seabed (10s of centimeters to meters). Another objective is to examine, through monitoring of sediment traps, the deposition of sediment escaping the shelf and reaching the continental slope.

In addition, the overall STRATAFORM program is coordinated through efforts to: orchestrate program planning, organize field operations, and disseminate scientific results.

APPROACH

Rapid-response box coring occurred immediately after two very large floods of the Eel River (Jan 95 and Jan 97) and a large ocean storm (Dec 95). Subsequently, the shelf has been examined several times each year by box coring, and recently by piston coring. Investigations of sediment size and fabric are put into a chronologic context using a suite of radioisotopes (^{7}Be, ^{210}Pb, ^{137}Cs, ^{14}C), which are relevant for a variety of time scales (months to millennia).

Monitoring of sediment escape to the continental slope is performed at a mooring located north of the Eel River mouth in a water depth of 450 m (at site Y450). Three sediment traps (depths of 65, 200, 435 m) are maintained continuously, and the temporal variability of sediment fluxes (quantity and composition) is observed on time scales of 10-16 days in sequentially rotating cups.

WORK COMPLETED

During FY97, sediment samples were collected on three cruises. A major flood on New Year's Day led to rapid-response coring in January (on *R/V Wecoma*), and subsequent coring in May (on *R/V Point Sur*). In July, a longer cruise examined the correlation length scales for the 1995 and 1997 flood deposits, and collected 35 piston cores on the continental shelf. The slope mooring and its sediment traps were recovered/redeployed on the January and July cruises. These and previous samples were processed in the laboratory, and a portion of the results was prepared for presentation and publication.

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RESULTS

a) Event deposits and their modification - ^{7}Be observations demonstrate that the 1997 flood deposit had greater spatial coverage (especially southward and seaward) than the 1995 flood deposit. Non-steady-state ^{210}Pb profiles imply that flood sediment enters the head of Eel Canyon. Microfabric studies showed that the most energetic storm event (Dec 1995 storm) caused physical stratification at S50, had negligible net effect at S60, and deposited a thin (0.5 cm) silt layer at S70. Coarsening of the 1995 flood deposit (upper 2 cm) was most significant during the summer of 1995, apparently due to bioturbation. Replicate mixing coefficients (n=9) calculated from ^{234}Th profiles at S60 during summer 1997 were ~55 ± 20 cm^2/y (on both 100-m and 1000-m scales).

b) 10^2 y - 10^3 y sediment accumulation - ^{210}Pb profiles indicate that the spatially averaged shelf accumulation rate is about 4 mm/y (0.46$g/cm^2/y$), and the 100-y sediment budget accounts for about 20% of the Eel discharge (silt and clay) to the shelf. Greater than 60 ybp, the shelf accumulated coarser sediment at a slower rate. ^{14}C accumulation rates for ~2000 y were 1-3 mm/y.

c) Sediment deposition on slope - Most of the sediment supplied to Y450 is lithogenic material: 53%, 70% and 83% at the top, middle and bottom traps, respectively. More than half of the flux (~1-10 $g/m^2/d$) integrated over the past two years is associated with events that correlate with periods of Eel River floods and/or increased shelf resuspension. The flux into the middle trap can account for more than two-thirds of the net accumulation rate at this site (6.6 $g/m^2/d$), indicating significant importance for intermediate nepheloid layers.

d) STRATAFORM coordination - Program planning was completed at the annual meeting (AGU, Dec 96) and several workshops: slope (Jan 97), long borings (May 97) and shelf (Aug 97). In addition to the three large cruises (*Wecoma, Point Sur, Melville*), 18 day-cruises occurred on the *Warrior II* for instrument recovery/deployment and rapid responses. Scientific results were disseminated at a special session of AGU (Dec 96) and were summarized in a special volume of *Oceanography* (1996). Much progress was made toward completion of the *Marine Geology* special issue, which compiles the results from Phase I.

IMPACT/APPLICATIONS

For a mountainous collision margin (typical of the Pacific Ocean), this research provides data needed to understand strata formation and allows specifically for better interpretation of long cores recording the environmental history of the Eel margin. Because much of the insight gained about strata formation is generic in nature, this work interfaces at the short and intermediate time scales of the nested spectrum studied by STRATAFORM.

TRANSITIONS

The research results are being utilized by numerous other STRATAFORM groups; for example: by shelf seabed group, because microfabric and radioisotope profiles are part of the integrated effort to document seabed characteristics; by boundary-layer hydrodynamics group, because observations document the seabed at instrument sites; by plume-dynamics group, because flood deposits demonstrate the fate of plume sediment; by slope sedimentation group, because trap fluxes document sediment deposition rates; by stratigraphic modeling group, because sediment accumulation rates and biological mixing rates are important parameters.

RELATED PROJECTS

As described above, examples of the related projects are: R. Wheatcroft, shelf seabed; R. Sternberg, boundary-layer hydrodynamics; R. Geyer, plume dynamics; C. Alexander, slope sedimentation; D. Swift, stratigraphic modeling. The entire STRATAFORM program is related to the efforts for program coordination.

REFERENCES

See the STRATAFORM web site at: http://pccad.msrc.sunysb.edu